10. Zhou W, Felkai DD, Evans M, McCoy SA, Lin PH, Kougias P, et al. Ultrasound criteria for severe in-stent restenosis following carotid artery stenting. J Vasc Surg 2008;47:74-80.
11. North American Symptomatic Carotid Endarterectomy Trial (NASCET) Steering Committee. North American Symptomatic Carotid Endarterectomy Trial: methods, patient characteristics, and progress. Stroke 1991;22: 711-21.
12. Lin SC, Trocciola SM, Rhee J, Dayal R, Chaer R, Morrissey NJ, et al. Analysis of anatomic factors and age in patients undergoing carotid angioplasty and stenting. Ann Vasc Surg 2005;19:798-804.
13. Setacci C, de DG, Chisci E, Setacci F, Pieraccini M, Cappelli A, et al. Is carotid artery stenting in octogenarians really dangerous? J Endovasc Ther 2006;13:302-9.
14. Ohki T, Timaran CH, Yadav JS. Technique of carotid angioplasty and stenting. In: Moore WS, editor. Vascular and endovascular surgery: a comprehensive review. 7th ed. Philadelphia, PA: Saunders Elsevier; 2006. p. 355-82.
15. Stradness DE. Duplex scanning in vascular disorders. New York: Raven Press; 1990.
16. Yadav JS, Wholey MH, Kuntz RE, Fayad P, Katzen BT, Mishkel GJ, et al. Protected carotid-artery stenting versus endarterectomy in high-risk patients. N Engl J Med 2004;351:1493-501.
17. Gurm HS, Yadav JS, Fayad P, Katzen BT, Mishkel GJ, Bajwa TK, et al. Long-term results of carotid stenting versus endarterectomy in high-risk patients. N Engl J Med 2008;358:1572-9.
18. Peterson BG, Longo GM, Kibbe MR, Matsumura JS, Blackburn D, Astleford P, et al. Duplex ultrasound remains a reliable test even after carotid stenting. Ann Vasc Surg 2005;19:793-7.
19. Fleming SE, Bluth EI, Milburn J. Role of sonography in the evaluation of carotid artery stents. J Clin Ultrasound 2005;33:321-8.
20. Chahwan S, Miller MT, Pigott JP, Whalen RC, Jones L, Comerota AJ. Carotid artery velocity characteristics after carotid artery angioplasty and stenting. J Vasc Surg 2007;45:523-6.
21. Younis GA, Gupta K, Mortazavi A, Strickman NE, Krajcer Z, Perin E, et al. Predictors of carotid stent restenosis. Catheter Cardiovasc Interv 2007;69:673-82.
22. Bosiers M, Deloose K, Verbist J, Peeters P. Review of stents for the carotid artery. J Cardiovasc Surg (Torino) 2006;47:107-13.
23. Hart JP, Peeters P, Verbist J, Deloose K, Bosiers M. Do device characteristics impact outcome in carotid artery stenting? J Vasc Surg 2006; 44:725-30.
24. Whitlow P. Registry Study to Evaluate the NeuroShield Bare Wire Cerebral Protection System and X-act Stent in Patients at High Risk for Carotid Endarterectomy (SECURITY). http://www.tctmd.com/Show.aspx?id=49406. Accessed November 10, 2008.
25. Gray WA, Hopkins LN, Yadav S, Davis T, Wholey M, Atkinson R, et al. Protected carotid stenting in high-surgical-risk patients: the ARCHeR results. J Vasc Surg 2006;44:258-68.
26. Schillinger M, Gschwendtner M, Reimers B, Trenkler J, Stockx L, Mair J, et al. Does carotid stent cell design matter? Stroke 2008;39: 905-9.
27. Robbin ML, Lockhart ME, Weber TM, Vitek JJ, Smith JK, Yadav J, et al. Carotid artery stents: early and intermediate follow-up with Doppler US. Radiology 1997;205:749-56.
28. Berkefeld J, Martin JB, Theron JG, Zanella FE, Guimaraens L, Treggiari-Venzi MM, et al. Stent impact on the geometry of the carotid bifurcation and the course of the internal carotid artery. Neuroradiology 2002;44:67-76.

Submitted Jul 29, 2008; accepted Oct 5, 2008.

DISCUSSION

Dr Allen Hamdan (Boston, Mass). I think you bring up a really crucial set of data here that we need to all look at, especially as this becomes a more common situation. I am just going to go right to some of the questions for the interest of time.

Have you looked at follow-up duplex—3, 6 months, a year down the line—in these patients, and do these PSVs [peak systolic velocities] persist over time, or is this just something you see early?

You didn't mention anything on, or at least I didn't see in the paper, on recurrent stenosis. So was there a disproportionate number of patients who had recurrent stenosis that maybe got closed cells or open cells and that could have affected your data?

As a corollary, are there any other anatomic criteria that you found, either on CTAs [computed tomography angiographies] or angiograms that could have predicted, potentially, these changes?

And finally, have you looked at any of the published clinical trials and looked at trials that had a higher proportion of closed-cell stents, and in those trials is there a higher in-stent restenosis quoted that maybe is a false elevation?

Dr Damon S. Pierce. In answer, in brief, I think a few of your questions dovetail into one, and that is that the data we have presented were derived from immediate postintervention duplex scans and we do not have a substantial follow-up data at this point. That is what we plan to do, to see if these elevations and the discrepancies persist through follow-up duplex examinations.

I don't have any specific published reports that I can cite that demonstrate disproportionality between closed- and open-cell stents as you mention in regard to in-stent restenosis.

And no, we did not find any anatomic criteria for recurrent stenosis.

Dr Massoud Alipour (Newport Beach, Calif). I'm a cardiologist and vascular technologist. I do hands-on studies. This is a fact well known in the last, at least 4, 5 years, that intrastent velocity increases because of very low compliance of the stent; therefore, your systolic velocity is expected to rise and your diastolic velocity is expected to decrease, not increase, because there is no rebound in the stent in the area with very low compliance.

What you really considered false-positive, all of them are true-negative. This shouldn't be considered false-positive, because even the criteria that you are using are very loose criteria. The ICA/CCA [internal carotid artery/common carotid artery] velocity ratio of 1.7 is not significant at all. It should be considered true-negative. And what you have mentioned about velocity of 125 normal and velocity ratio of 2, this should be considered hemodynamically not significant at all. So what you are mentioning as false-positive, I believe, again, is true-negative and is quite expected.

Dr Pierce. That was not the aim of our study. The aim of our study was to compare stent design differences in carotid velocities, not in regard to the frequency of abnormal duplexes. We understand that changes in elastic modulus generated by different stent designs alter the compliance of the carotid artery after stenting. What is significant in our data is the difference in carotid velocities and the increased odds ratio of a closed-cell stents to yield abnormal duplex velocities after carotid stenting.

Dr Jeffrey Hsu (Fontana, Calif). I just have a quick question for you. First, a comment: We have also noticed an elevation of velocities in our stents and we have been following our patients with duplex. We have now changed our practice to get a postoperative duplex, basically prior to discharge, based on the assumption that we are going to need some sort of baseline to compare to, rather than to bring them back 6 to 8 weeks later, or 3 months or other interval. So the question is, is a postprocedure ultrasound before discharge something you recommend?

Dr Pierce. Well, it is tough to say based on these data, and I think we will have more of an answer when we follow this subset of patients to see if these elevations in velocities persist. But I think it may be a good piece of data to have a baseline duplex before a patient leaves the hospital.

Dr Martin Back (Tampa, Fla). Balloon size is going to influence the residual diameter after angioplasty of stented stenoses and therefore the postprocedural velocities. You need to make sure that the balloon sizes that were used in your cases were equivalent in those two groups for residual velocities to not differ.